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Close to Nature: Biological Field Stations - - Homer A. Jack 141

Evolution of Boston Fern Varieties - - - Glenn W. Blaydes 145

The Biological Field Trip - - - - - - H. I. Featherly 147

A Wild Flower Exhibit for High Schools and Colleges - - - - - - - Harry L. Bauer 149

Everyone Needs Biology - - - - - - H. Keith Cady 152

Teaching Aids - - - - - - - - 155

Books - - - - - - - - - - - 156

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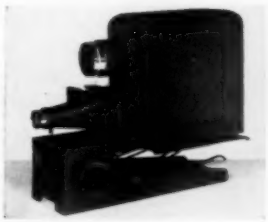

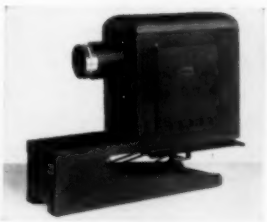

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The American Biology Teacher

Vol. 2 MARCH, 1940 No. 6

Close to Nature: Biological Field Stations*

HOMER A. JACK

Science Education Department, Cornell University

Biological field stations are summer schools located away from hot cities and crowded campuses, near cool forests and lone beaches. They are sponsored by institutions of higher learning with the hope of bringing *living* biology within the reach of school teachers and scientific investigators, of undergraduate students and camp councilors. Living at these field stations is close to nature—yet not uncomfortably so, for there are usually modern cabins in which the students reside, when not straying by day or night to study various aspects of the environment.

Formal classes are rare and there are seldom texts—except the melodious thicket in the early morn, the pine forest at mid-day, and the swift brook at sunset. Students visit marsh and moraine, field and hedgerow with competent, experienced instructors—experienced not in pedantry or the ability to recite long, scientific names (although they can do this, too), but trained by persistent field work to interpret the out-of-doors. The better instructors create—in the willing student and erstwhile teacher—an understanding and appreciation of the environment by giving him the opportunity to reach with his senses all those things which heretofore he found only in books: the poignant grace of the yellow lady-slipper, the cadence of the peeper's shrill note, the pneumatic uncertainty of the peat bog, the rich anisine fragrance of the wild azalea, and the walnut flavor of the touch-me-not seed.

The mechanics of attending one of these field stations is simple, as there are usually no requirements for the less advanced courses except a college or normal school education and an interest in the biological sciences—even if that interest were badly shattered by long hours of teaching with well-pickled specimens and

* Adapted from a paper given before the meeting of the American Nature Study Society at the 1939 convention of the American Association for the Advancement of Science.

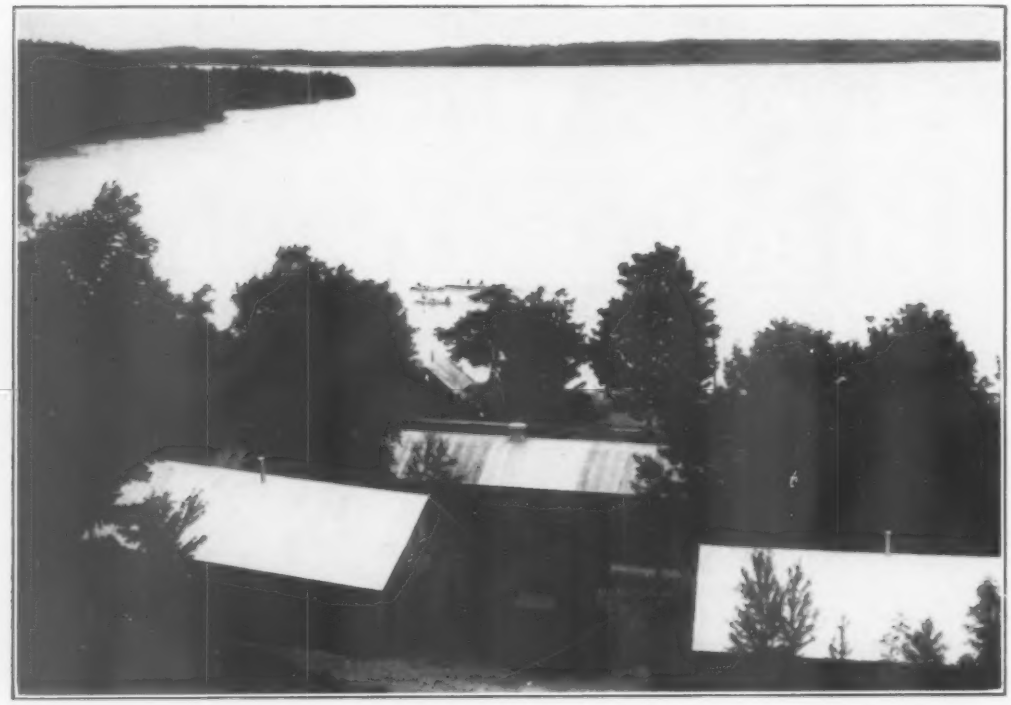

FIG. 1. . . . near cool forests and lone beaches: the site of the Biological Station of the University of Michigan.

equally preserved textbooks. During the summer months the stations are in full operation, and the sessions vary from two weeks to nine, some beginning in early June and others in late August. The cost—including board and lodging, tuition and excursions—averages somewhat less than $17.00 a week—a moderate sum, considering one is combining education with recreation, vocation with vacation.

After a period at one of these stations, the teacher returns to his or her classroom rich not in credit hours (although most stations offer these, too), but rich in knowledge of the out-of-doors and replete with the power of making biology more attractive and vital to the student. Attendance at a field station will not only reinvigorate the teacher for subsequent schools years, but will put enthusiasm and knowledge into his instruction —whether it be in the second grade or the twelfth, in biology or general science, in a rural school or an urban educational factory.

* * *

Following is an annotated list of the biological field stations in the United States which offer formal course work to teachers and camp councilors as well as to undergraduate and graduate college students. With the name of each station is given its location, the number and length of its sessions,[1] the approximate time the session begins,[2] the names of the

[1] This and subsequent information is given on the basis of the 1939 session at most of the stations, as information on the 1940 sessions was generally not available at the time this manuscript was prepared.

[2] In cases where there are two or more sessions, only the date of the first session is listed, if one immediately follows the other.

FIG. 2. . . . bringing *living* biology within the reach of teachers and investigators: the site of the Rocky Mountain Biological Laboratory.

courses offered, the costs of attending each session (total costs include tuition, board, and lodging),[3] and the name and address of the director—to whom inquiries may be sent for further information.

California

1. Pacific Union College Field Nature School. An itinerant field school with headquarters at Angwin, Napa County. Four-week session, every even year, beginning about July first. Course offered to give students and teachers a working knowledge of nature from first-hand observation. Total costs: $60. Prof. Harold W. Clark, Pacific Union College, Angwin.

2. Laguna Beach Marine Laboratory. Laguna Beach. Six-week session, beginning about the last week in June. Courses offered in biology of the vertebrates and invertebrates, human biology, human origins, and animal ecology. Tuition: $40. Prof. William A. Hilton, Pomona College, Claremont.

3. Scripps Institution of Oceanography. La Jolla. Courses offered in marine meteorology, physical oceanography, marine geology, chemical oceanography, marine microbiology, phytoplankton, marine invertebrates, marine biochemistry, and biology of fishes. Tuition: $75 (for non-residents of California). Dr. Harald U. Sverdrup, Scripps Institution of Oceanography, La Jolla.

4. Hopkins Marine Station. Pacific Grove. Two nine-week sessions, beginning about the

[3] When only the tuition is listed, board and lodging is not ordinarily given at the station, but may be obtained at private boarding houses or hotels within a reasonable distance from the field station.

FIG. 3. . . . experienced instructors interpret the out-of-doors: a bird study class at the Allegany School of Natural History.

first of April and the first of July. Courses offered in ecology of marine organisms, marine biology, marine invertebrates, marine fishes, marine algae, general microbiology, comparative physiology, physiology of marine plants, and experimental embryology. Tuition: $100. Professor Walter K. Fisher, Stanford University, Palo Alto.

5. West Coast School of Nature Study. In various localities in California, with headquarters at San Jose. Four one-week sessions. Courses offered in bird-study, flowers, trees, rocks, land-forms, nature games and methods, and insects and related animals. Tuition: $12. Prof. P. Victor Peterson, San Jose State College, San Jose.

6. Santa Barbara School of Natural Science. Santa Barbara. Two-week session, beginning about the second week in August. Courses correlated around the integral theme of the conservation of natural resources. Tuition: $12. Prof. Harrington Wells, Santa Barbara State College, Santa Barbara.

7. Yosemite School of Field Natural History. Yosemite National Park. Seven-week session, beginning the last full week in June. Special emphasis given to methods of interpreting living nature in the fields of botany, entomology, forestry, geology, mammalogy, and ornithology. Total costs: $90. C. A. Harwell, Yosemite National Park.

Colorado

8. Science Lodge. Nederland. Two five-week sessions, the first beginning about the third week in June. Courses offered in plant forms, systematic botany, bryophytes, ornithology, limnology, bio-ecology, entomology, and in many phases of geology. Total costs: $125. Prof. Warren O. Thompson, University of Colorado, Boulder.

9. Rocky Mountain Biological Laboratory. Gothic, Gunnison County. Six-week session, beginning about the last week in June. Courses offered in ecology, field botany, and parasitology, and in other biological sciences and geology if there is sufficient demand. Total costs: $130. Dr. John C. Johnson, 26 Price Street, West Chester, Pennsylvania.

Connecticut

10. Science of the Out-of-Doors. Lakeville. Four-week session (although one, two or more weeks' work may be taken), beginning about the second week in June. Course offered to give teachers guidance in the utilization of features in the natural phenomena of the out-of-doors. Total costs: $121. Prof.

F. L. Fitzpatrick, Teachers College, Columbia University, New York City.

Illinois

11. University of Illinois Animal Ecology Study Trip. An itinerant field trip, with headquarters at Urbana. Trip given to a different locality every third year (1939, 1942, etc.). Prof. V. E. Shelford, University of Illinois, Champaign.

(To be continued next month)

Evolution of Boston Fern Varieties[1]

GLENN W. BLAYDES
The Ohio State University

Accurate records of the origin of the Boston fern (*Nephrolepis exaltata bostoniensis*) and its many varieties compose one of the most complete histories of any cultivated plant. The Boston fern mutation was discovered among 200 Sword ferns by a florist near Boston in 1895. The Sword fern (*Nephrolepis exaltata*) is native in Florida and throughout the American tropics. This wild species was introduced at Kew in 1793 from Jamaica. For 100 years it remained stable, and by 1895 it was used widely as a house plant. The Boston fern was more desirable as a house plant, and gradually replaced the wild species almost entirely. Benedict (1916) estimated that from 1,000,000 to 2,000,000 Boston fern plants are propagated each year in the United States. Plants from the southern states, and from the western, northern, or central part of the country, could not be distinguished from those of eastern Massachusetts. However, six exceptions to this statement must be noted. Within a few years of each other there appeared in the greenhouses of commercial growers in five states, amid countless thousands of normal Boston ferns, six mutations now known as Scott's fern (*Scotti*), Giatra's fern (*Giatrasi*), Pierson's fern (*Piersoni*), Foster's fern (*Fosteri*), Harris' fern (*Harrisi*), and the Roosevelt fern (*Roosevelti*).

From these six mutants numerous other varieties have been derived, many of which have not been named. Within the 45 years since the Boston fern appeared, over 200 varieties have come into existence, many gaining commercial importance.

Some of the noteworthy facts concerning these numerous mutants are as follows:

1. From what was originally a stable species a mutant (Boston fern) was discovered among thousands of Sword fern plants after the species had been cultivated for about 100 years.

2. The wild species (*Nephrolepis exaltata*) produces fertile spores, but the Boston fern and all of the derived varieties are sterile, except one (*Nephrolepis exaltata bostoniensis fertilis*). *Fertilis* was a mutant from *Piersoni*.

3. The Boston fern is of such a xerophytic type that it can withstand the dry atmosphere of the average home—which is drier than desert air. The other extreme is reached in a form which must be kept in a saturated atmosphere to keep it alive.

4. One variety, *elegantissima-compacta*

[1] Papers from the Department of Botany, The Ohio State University, No. 425.

cristata, reproduces by viviparous budding of the leaves. Viviparity is a new character in the genus *Nephrolepis* and probably is present only in one rare species, *Dennstaedtia circutarioides*, in the whole fern tribe Davalliae.

5. Length of leaves range from 27 feet —a report by John K. Small for a wild plant (*Nephrolepis exaltata*) in Florida —to *Cristata* which has leaflets bunched into a spherical mass about one inch in diameter.

6. The wild species, as well as the Boston fern, are once pinnate and with no cresting of the leaflets. This ranges through all degrees of pinnation to forms which are five or six pinnate with many showing cresting.

7. Definite parallel evolutionary series (orthogenetic series) have been established from several lines.

8. Over 200 varieties have appeared within a period of 45 years.

9. These mutations have appeared in an environment which is comparatively uniform throughout. The temperature for fern greenhouses ranges from 50 to 70 degrees F. Light intensity, watering, and soil used is fairly uniform in commercial houses.

10. The variation for the whole group is so great that if they had been discovered originally in nature many new species and even new genera would have been named. Apparently here are species and perhaps genera in the act of origin.

Ordinary florists establishments usually are able to supply the following varieties:

Nephrolepis exaltata Bostoniensis
" " *compacta*
" " *curly compacta*
" " *frombrebata*
" " *Scotti*
" " *Smithi*
" " *superbissima*
" " *Teddy Jr.*
" " *Wekwia*
" " *Whitmani*

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The Biological Field Trip

H. I. FEATHERLY
Botany Department, Oklahoma A. and M. College, Stillwater, Oklahoma

A successful field trip is similar in many respects to a well-executed narrative. It is a succession of events, and the method of handling them as they naturally arise, or are created by the instructor, determines the degree of success of the trip. A field trip may have a preconceived object which may or may not be known to the class, or it may be more or less of an exploring expedition in which the instructor is an inconspicuous but efficient leader; but whether it was preconceived or not, the field trip is its own excuse for being. Sometimes an unexpected event may change the entire course of the trip. Some surprise that you have not even suspected may profitably be investigated. The drama of nature presents a continuous show and you may chance by just as it is putting on a choice act.

The Instructor

The personality and qualifications of the instructor are most important in the success or failure of a trip. A pleasing personality, neat appearance, and a sympathetic understanding of the students of the class are of inestimable value —second only to his qualifications as a biologist. The instructor should have a considerable knowledge of both field zoology and field botany so that he can call attention to or take advantage of phenomena in either field and emphasize the relationship of one to the other. The conservation of wildlife and natural beauty should be kept before the students at all times. They should be led to realize that a plucked flower soon wilts and produces no seed, while one that is left on its stalk may perpetuate itself and be admired by numerous people who may chance to pass that way in the future.

Kinds of Field Trips

The purpose of a field trip may be either specific or general. There may be a certain phenomenon which you wish the class to see, such as an outbreak of insects or blooming of certain plants, etc., in which you go for a definite purpose. The general field trip is more common and offers a wider range of interest, although each serves its respective purpose equally well. Since the general field trip requires more skill, most of this discussion will be devoted to it.

A Short Field Trip

The length of a field trip should be governed by time, purpose, and desire. These trips may be made with profit within walking distance of almost any school. An interesting trip may be made to a shade tree on the lawn. Let us suppose that we make such a trip in late spring. The following questions and many others may present themselves concerning this tree and the many little creatures that are living in it, on it, or under it.

What kind of tree is it? Where is its native home? What is its distribution? Is it growing in its natural habitat? What are the distinguishing characteristics which separate it from other trees? Of what importance is the tree economically? What kind of flowers and fruits does it bear? What living creatures are found in the tree?

Are there ants on the tree? If so, what are they doing there? Is their home in the tree? If not, where is it? Are they seeking food? If so, are they eating the tree, or is it something on the tree? If so, what? What other insects are in the tree? What are they doing? Can you find cases of symbiosis, parasitism, ephiphytism, or predator and prey?

Is there a bird nesting in the tree? If so, what is it? What are its distinguishing characteristics? What do you know of its habits? Does it build an elaborate or simple nest? What materials has it used in the nest? Is the nest high up in the top or low? Is it in a crotch or swinging from a twig? Is it reasonably safe from predators? Does this species always build its nest in a similar location? What food does the bird eat? Is it a summer resident, a winter resident, or a permanent resident? Is it considered harmful, neutral, or beneficial?

Is there a hole in the tree? If so, what caused it? Is there anything such as a woodpecker, screech owl, squirrel or perhaps a spider living in it? If it is a spider what sort of web has it spun? Does the web have any special device for catching its prey? Is the spider a poisonous species? How can you identify the poisonous species? What poisonous species are found in this locality?

Now let us see what is of interest under the tree. What kind of grass is this? How do you distinguish grasses from other groups of plants? How many little creatures can you find living in the grass? Are they the same kinds as those living in the tree? How do you account for the difference? Can you say that this biotic community is made up of horizontal layers?

The above are some of the possible questions that might arise in relation to almost any tree, and illustrates in a brief way a procedure that might be followed where space and time are limited. Where facilities are adequate for more extended trips, the instructor must adjust his questions and observations to suit the occasion. Be able to call attention to something interesting wherever you stop.

Transportation

When transportation by automobile is necessary to convey the class to some distant point, it is well to assign students to the respective cars, otherwise they may all try to ride in the best-looking car. This also gives the instructor a chance to discourage cliquishness and prevent the obtrusion of romantic interests among students. Assign cars to a certain position in the procession, in order to prevent racing and lessen the possibility of accident in transit. The instructor should lead the procession and inform the drivers not to get out of sight of the car behind them. This will keep the procession together and if a car develops trouble it will have help and not be lost. One car should carry a "first aid" kit.

A Wild Flower Exhibit for High Schools and Colleges

HARRY L. BAUER
Santa Monica Junior College, Santa Monica, California

The idea of a public wild flower exhibit given by the school is not new. In various forms and magnitudes such exhibits have been staged by every grade from the primary grade to the university. It is quite likely, however, that considerable benefit would result from an extension of the use of the wild flower exhibit in the upper high school years, and in the junior colleges.

A timely display of local wild flowers, arranged by botany and biology classes, and to which the general public is invited, may function in two important ways, namely (1) providing all the elements of an excellent educational project for a class or department and (2) stimulating wholesome relations between school and public.

As a large scale project, the successful staging of a wild flower show is a many-sided activity and makes possible the integration of the diverse interests of the members of a class or larger group of students. Much knowledge of botanical fact and technique is, of course, needed in collecting and identifying the specimens. In addition to this, the artistically inclined have an opportunity to express themselves in the matter of providing suitable containers, arranging the flowers in bouquets and arranging the bouquets on the tables and in the racks, and in the general decoration of the exhibit room. Those with talent in drawing may make posters for placing in public places, and embryo journalists can see to getting suitable articles in the local papers. For those with special interest in drafting and lettering there are many labels and placards to be printed. For those handy with tools there are numerous things to be built such as racks for vases, standards on which to support placards, and other articles. All of this constitutes a very considerable effort and undertaking. With proper guidance by the instructors, the students develop a good deal of interest and enthusiasm and the various tasks are completed without great confusion or disturbance of class routine.

As a means of keeping the public interested in what the schools are doing, the wild flower show is very effective. The response on the part of the community is likely to be surprising and gratifying. If the display is at all extensive, the citizens will be pleased to have the opportunity of seeing the labeled specimens and learning the names of some of the species. Their visit to the campus will be under pleasant conditions and good feeling will result.

For several years the Santa Monica Junior College has given a free, public, wild flower exhibit and it has now come to be one of the major campus activities. It is usually attended by from 1500 to 2000 people. To enlist the interest and help of the students in the botany classes, the matter is presented to them early in the second semester. Below is a copy of a mimeographed list of personal contributions which may be made by individual

students. Each student is asked to consider the list and check the things that he is willing to do.

I would like to help stage the ANNUAL WILD FLOWER EXHIBIT of the Santa Monica Junior College by contributing my services for the things checked below.

Name .....

PUBLICITY

—— 1. Obtain newspaper publicity
—— 2. Make personal announcements in public places

ART WORK

—— 3. Make posters for public bulletin boards
—— 4. Design and cut stencil for small handbill

FREEHAND LETTERING

—— 5. Print labels for individual bouquets
—— 6. Print large placards with explanations

CARPENTRY

—— 7. Build wooden rack for display of flowers
—— 8. Build small stands to use on top of tables
—— 9. Build small easels to support placards

PREPARATION OF CONTAINERS

——10. Supply a number of wide-mouthed glass jars
——11. Wash and paint glass jars

COLLECTIONS OF FLOWERS

——12. Visit nearby floral areas prepared to collect
——13. Visit a more distant area prepared to collect

FLOWER ARRANGEMENT

——14. Arrange flowers in containers
——15. Decorate and arrange exhibit room

ADDITIONAL SUGGESTIONS

.....

.....

After these lists are returned, the teacher has many offers of help for the various activities. Generally speaking, the student response is wholehearted and fine; nearly everyone sincerely wishes to make some contribution of his own. The many-sided nature of the affair makes it possible for each to utilize his own special talents.

Most of the specimens in the Santa Monica display are of the showy-flowered kind, but one section consists of grasses and weeds, and another one of the trees and shrubs that are native to this region. We usually have 150 or more different species in the exhibit. Large bouquets are not considered desirable but, in most cases, something more than just one specimen in a container is necessary to produce a good impression of the exhibit as a whole. The use of racks and small stands to support some of the bouquets above the general level of the table tops further enhances the general appearance of the room. Without this the flowers are all at the same level and the display looks too flat.

Every reasonable effort should be made to have the exhibit as a whole look well, if the general public is to be invited. The containers play an important rôle in this matter. A fine display can be greatly impaired by using as vases a nondescript collection of coffee cans, milk bottles and pickle jars. We found that it is not particularly hard to attain considerable uniformity and attractiveness in the matter of containers by specializing on pint and quart, wide-mouthed, straight-walled, glass jars. These are painted green on the inside. The painting is a simple matter. After the jar is

clean and dry, a little paint is put inside and the jar rotated until the inner surface is entirely covered. Excess paint is drained out and the jar allowed to dry. After the exhibition is over, the jars are wrapped up and packed away to be used again the next year.

Uniformity in labels is just as desirable as in containers. We use a four-by-six-inch white card and print the label on the lower half. The upper half of the card is left free so that the specimen jar may be placed upon it and thus hold it securely in place. The common name of the plant is given in large capital letters and below this, in smaller letters, is mentioned the botanical name and the common name of the family represented. Sometimes other comments about interesting features of the flowers are added to the card. These carefully printed labels are kept and used from year to year.

All botanical identifications should be correct. Unless the teacher happens to be a trained taxonomist, it may be somewhat difficult to obtain authoritative determinations. However, in most communities there are persons competent to identify the local species, who are willing to cooperate. Specimens can be sent to state universities or museums for determination. If pressed specimens of each of the species for which accurate identifications are secured, are kept for future reference, the task becomes less difficult each succeeding year. These can be conveniently kept in the form of a scrapbook, if herbarium filing cabinets are not available. Such a collection of pressed plants can be used in different ways at various times throughout the year.

The variety of plant life is so great in most places that enough specimens can be collected on short local field trips to make an effective exhibit. However, there will be considerable improvement in the display and its educational benefits if a longer, carefully planned collecting trip can be taken. A large number of the bouquets in the Santa Monica show are collected during the course of a two-day trip on the week-end preceding the date of the exhibition.

This trip is sponsored by the Botany Club and usually includes some of the flower fields in the San Joaquin Valley and Mojave Desert. As the flowers are picked their stems are wrapped in water-soaked cloth or paper, and placed in boxes in the trunks of the cars. Upon arriving in the city, the flowers are immediately taken out of the boxes and placed in pails of water. Most of the flowers remain fresh until Tuesday, the day of the show. Monday is devoted to the preparation of the exhibition room.

In collecting flowers in the field a real snag may be encountered in the matter of wild flower protective legislation. In recent years much wanton destruction of native flora by unthinking people has made desirable the passage of laws in the interest of wild flower conservation. Some of this is in the form of state statutes but most of it is in the form of county ordinances intended to fit local conditions. However, in their zeal to protect, some agencies have been overly enthusiastic and secured the passage of laws giving blanket protection to all plants, including noxious weeds, and leaving no legal loophole for educational and scientific collecting. This is an unnecessary stumbling block in the path of progress in nature study. It should be given consideration by legislative bodies. In places where plants may not be legally collected, it is necessary to get written permission of land owners, forest supervisors, or whatever authorities may be in charge. Incidentally, the explanation of this situation to students offers an excellent opportunity for discussing the need

and the means of the great cause of conservation of wild life.

From the foregoing account it is apparent that the staging of a public wild flower exhibit involves much work and effort, especially for the teachers. The rewards, however, in the form of educational results, stimulated student interest, and public appreciation will justify the effort.

Everyone Needs Biology

H. KEITH CADY
South Milwaukee Jr.-Sr. High School, South Milwaukee, Wisconsin

The State of Wisconsin requires that some conservation and physiology be taught in our schools. We have, therefore, decided that these requirements could best be met in a course of biology. As a result, our biology course is required of all tenth-grade students.

Last year during the first few months of school, students often confronted me with the following questions: "Why do I have to take biology, I want to become a stenographer and will never use this stuff?" or "I plan to become a machinist, why should I take biology?" All the questions were just, and needed honest answers. Of course I was already sold on biology, but had never before consciously tried to give definite answers to such questions. Therefore, the following scheme was tried which I recommend to anyone.

Each of my biology students filled out a questionnaire which I had worked out at summer school. One of the request statements was: "List the vocations, in order of preference, that you would like to enter as your life's work after leaving high school." Another important request was: "List, in order of preference, your avocations or hobbies (*i.e.*, what you enjoy doing during your leisure time)." Many other routine questions were asked that would help me to understand the student's home life as well as his school life.

I wanted each student to find out all he could concerning the vocation and avocation in which he was most interested, then to find the relation of biology to it. However, I realized that for a start we should not investigate too large a field, and therefore after a good round-table discussion with my classes, we decided to find out first how biology was related to all vocations. This later proved to be our complete project for the school year.

Each student agreed to find at least three persons, working or living in or near South Milwaukee, whose vocation was the same as his first choice of a future vocation. The student was to make definite appointments with these persons, and then record the interviews exactly as agreed. Inasmuch as the students had not finished the year's class work, very few of them knew exactly what the entire course of biology included. Therefore, a list of the principal units, sub-units, subjects, etc., usually studied in a general biology course, was given them to refer to while interviewing.

Many little difficulties had to be "ironed out" at first. For example, some of those interviewed had never taken a course in biology and the interviewer had to explain what biology con-

tained. A few didn't want to cooperate and were too busy to help any. Nevertheless, when the deadline came for getting their reports in, they proved to be nearly one hundred per cent successful. All interviews were sorted into groups of the same vocation. Final analysis found that the students had interviewed two hundred and fifty-six local people working in twenty-seven different vocations.

Several of my better students compiled a summary of all the interviews. They made an individual summary for each of the twenty-seven vocations. Grammatical errors were corrected as well as they (sophomores in high school) could do it. The last week of school, these summaries were put in a fifteen-page mimeographed form and sold (at cost of paper and work) to all students interested. Believe it or not, over two-thirds of the students in biology bought personal copies.

These copies of our survey went into many homes of the community, and not only helped popularize biology, but helped advertise the school in general. So many parents and students have commented upon the value of such a survey that I feel it was well worth all the work. Before the school year ended a noted increase in student interest for the subject could be seen. Nearly everyone had discovered some real purpose in studying biology.

Following is part of one of the summaries of "Biology in Aviation." It is written in the words of a sophomore: "Biology plays a very important part in the life of an aviator. Neat appearance of the skin, hair, and nails helps a lot. An aviator must have perfect eyesight and hearing. The brain must be in perfect condition so that he can think clearly and quickly in an emergency. The digestive system of a pilot must be very good because his digestive system takes a lot of jarring when he is flying. The respiratory system of a pilot must also be very good because a pilot must sometimes go higher than he is supposed to, and if he did not have a good respiratory system he could not live very long. A pilot must by all means not be nervous; that is one of the worst things a pilot can be. Accidents often occur because the pilot got jittery and nervous and did not know what to do. Blood pressure must be normal. All transport-airline pilots must pass a very rigid physical examination often. That necessitates a pilot understanding his 'machine' (his body) and how to take care of it."

"A pilot must know about nature in general since he must judge heighth of trees, types of plants that grow in dry fields that are best in emergency landings. If the plane comes down in unknown territory, he should know that the presence of certain kinds of trees mean water is close, and that certain wild fruits are poisonous, while others are not."

And so on and on. . . . The summaries show various ways in which biology helps people in all walks of life. It need not be said that I have learned much myself by going over these surveys carefully.

This fall I have again had my biology classes fill out a questionnaire similar to the one described at the beginning of this article. Fifty vocations were mentioned by the students as those they wished to enter. It might be interesting to add that South Milwaukee is predominantly a manufacturing community, and that the vocations dealing with mechanical objects predominate very noticeably.

The majority of avocations listed by the students fall under the following: stamp collecting, making airplane models, making model cars and trains, woodcarving, making model furniture, reading, collecting match-box covers, singing, bicycling, swimming, tennis, athletics of all kinds, metal work, Boy Scout merit

badge work, Girl Scouts, sewing, phonograph record collections, collection of flower pictures, scrap-books of all kinds, caring for pets of various kinds, paper route work, and many others. The majority of the boys' hobbies are of a mechanical nature, while those of the girls are about the same as found in any average community survey.

Since only a small number of our students continue in regular academic college work, we must plan our course to be as practical as possible for everyone. Each year I am trying to make the course as useful and adaptable as possible to all my students' real wants and needs. Instead of assigning every student to interview various persons, I have supervised several discussion periods to let students profit by last year's survey and see what else could be done to impress them with the importance of biology. We have decided that each person is to complete one biology project each semester. These projects can be either of the following: a booklet, a poster, a written or an oral book report, a written or an oral report on some field trip, a model made of wood, clay, soap, etc. These projects must be on some biological subject that is in some way related to their choice of vocations, avocations, or other daily interests.

For example, one boy that is interested in aviation as a vocation, and wood carving as an avocation is making a large model of a common bird. A small booklet will accompany this, explaining the relationships between a bird and the airplane. A girl interested in stenography as a vocation is making a study of the anatomy, physiology, diseases, and the cure of diseases of the human hands. A boy interested in the machinist trade is making a survey of the common injuries and first-aid remedies for common shop-work injuries in local factories. A girl interested in nursing is reading a new fiction book about nursing and is making a written report. A boy interested in stamp collecting is making a survey of all the stamps he can find that have a predominance of nature scenes on them. These scenes will be described to show the difference between typical vegetation and wild animals found in various sections of the world. A girl interested in music is taking ten well-known "nature" songs and studying the plants and animals included therein. For example, she is finding out if there are such flowers as "Blue Orchids." If so, what are they like? In another case, one of our English teachers is cooperating with me on a student's project. A girl interested in becoming an English teacher as a vocation, and in collecting flowers as an avocation is writing a booklet all about her flowers. She will have the English teacher correct it grammatically, and let me correct it as to scientific accuracy. I imagine this could be called a "two-in-one" project. Many more examples could be enumerated, but the above list will illustrate my point.

By the end of this school year I will be better able to judge the practical results of our experiments. After three semesters' trial I can say only that the plan has worked thus far, and that I recommend its trial to any biology teacher confronted with the same situation as ours.

It is an accepted fact that every student is keenly interested in his personal success. If we can show that biology will help him better adapt himself to his vocation, avocations, and all personal life situations he now meets or is likely to meet in the future, then he really will work, will learn, and will appreciate the biology course. EVERYONE NEEDS BIOLOGY.

Teaching Aids

NATURAL COLORED PHOTOGRAPHIC SLIDES FOR CLASSROOM USE

With recent developments and improvements in the manufacturing of colored films has come increased ease in the taking of natural colored pictures. This makes it possible for every teacher to produce his own colored slides to meet the needs of his own course of study. These needs have heretofore been met by difficult and painstaking drawing of glass slides, photographing and printing black and white glass slides, or in other arduous ways. These methods required much time and then were not always accurate. The slides were delicate to handle and difficult to store. With this new method it is as easy as snapping any ordinary black and white photograph.

The camera I have been using is a $12.50 Argus using 35 mm. film. A camera taking this size film is more desirable because the most satisfactory colored film manufactured thus far comes only in this size, besides being the most practical for slide use. Camera prices in this size range from about $10.00 to $300.00 or more. Absolutely satisfactory results for classroom use may be obtained from the cheaper cameras.

As to film, I have found that *Kodak Kodachrome K 135* will produce very accurate color and is easily used by the amateur. There are 18 exposures in a roll of this film. In buying film be sure to specify whether you want it for indoor or outdoor use. There is a type made for each use, and if the proper one is used, no filters need be attached to your lens.

In taking pictures out-of-doors, it is better to "shoot" only in fairly bright weather and then with the aperture not less than f. 5.6 and shutter speed at more than 1/50 of a second. For absolutely correct exposures a photo-electric exposure meter is desirable. However, their price ($10.00 to $40.00) makes them unavailable to many camera users. An entirely satisfactory exposure guide card for colored film is put out by Eastman Kodak Company for ten cents.

Indoor shots are possible with the aid of photoflood bulbs and the indoor film. The burning life in a photoflood bulb is about two hours, which is sufficient time for you to take a great many pictures, and as a result the cost per picture is surprisingly low. More detailed directions for use of each type of film come with them.

The developing and mounting of the slides are done by the film manufacturer at no extra cost and the slides are returned to you ready for use. However, since they are not mounted between glass and in hard usage there is danger of the film getting scratched, you may desire a more permanent slide mount for your negatives. Two types of slide mount kits on the market are *Argus* and *Perfex 1–2–3 Speed Binder*. It requires only a minute to insert the negative and seal the binder.

The pictures may be projected up to almost any size. I have used them on screens fourteen by eighteen feet. Any projector equipped with a carrier for $2'' \times 2''$ slides will handle them.

A reference I have found particularly helpful in the use of colored film is *Color in Photography* by Ivan Dmitri.* It includes information on natural color film, mounting, projecting, types of subjects, etc.

The use of color in slides increases their effectiveness as an instrument of education. The reproduction of color through

* Ziff-Davis Publishing Co., 608 S. Dearborn Street, Chicago. Price 50¢; 96 pp.

this new medium is accurate to the highest degree. This fact makes it particularly valuable in science, especially in connection with nature subjects where coloration is so important.

Don C. Keesler,
Wilson Junior High School,
Muncie, Indiana

POLLEN TUBE GROWTH: CHEMOTROPISM

In order to illustrate pollen tube growth and the chemotropic movements of pollen tubes to the students, use a number of pollen grains from an available plant such as the narcissus, lily, snapdragon, or one of the composites. Place a drop of a specially prepared solution on a glass slide. This solution is made up of one gram of gelatine, four to five grams of cane sugar and fifty cc. of distilled water warmed until the solution is homogeneous. Add pollen to the drop of the solution. Cover with a cover glass. Keep it in a moist chamber at about 18° C. Examine eight or ten hours later. The pollen tubes will point towards the center of the preparation or away from contact with the air. Make a second preparation and treat as above, but seal the edges of the cover glass with vaseline to make it airtight. The germinating pollen tubes will grow in all directions.

Marcus Lilling,
Seward High School,
New York City

TEACHING PHOTOGRAPHY AS AN AID TO BIOLOGY

Mr. Worthington Prince of Vacaville Union High School, Vacaville, California, would like to hear from biology teachers regarding the status of photography teaching in their schools, especially as to the extent to which instruction in photography is carried over as an aid to instruction in the biology classes through the making of slides, film-strips, color transparencies, enlargements, etc. The data received will be summarized in The American Biology Teacher.

Books

Moon, T. J., and Mann, P. B., *Biology.* 866 pp. Henry Holt and Company, New York, 1938. $1.50. (Evaluation by Textbook Reviewing Committee.)

Mechanical Make-up

The publishers of this text have constructed a sturdy, serviceable book of almost a thousand pages. The paper is firm, and has a pleasantly printed, easily read typography. The authors use a limited number of line cuts effectively to illustrate their knowledge objectives. These diagrams, charts and pictures are admirably constructed, and have worthwhile stimulating legends. Many of the drawings are labeled by means of letters at the ends of guide lines. This method is far less desirable with respect to the saving of time and eyesight of the reader than the newer method of placing names of structures at the ends of guide lines. Footnotes and references are confined to the ends of the chapters.

Learning Exercises and Teacher Helps

This text is a revision of a successful edition that has been in use almost a decade. Its present revision attempts to follow its predecessor *Biology for Beginners* in having questions of a select nature at the end of each chapter. In addition there are reference lists on chapter topics. The present edition adds a number

of practical suggestions for pupil project activities. It also includes a list of key words planned to test the students' retention of the facts included within the chapter.

The text possesses a reference list, a fully elaborated glossary of terms and a valuable appendix of safety procedures.

Helps for the teacher in the form of a manual to explain the purpose and philosophy of each step, descriptions of setups for demonstrations, and keys for answering tests and questions are not provided.

Psychological Soundness

The sixty chapters are arranged in ten units. The authors have striven to convert an encyclopedic text with its wealth of detail and facts into a book which might stem from the apperceptions of the pupil. The great mass of facts, the scope of the approach to each unit, make a thorough mastery somewhat difficult.

The few practical suggestions for project activities and experiments that are included are excellent provision for individual differences among pupils.

Subject Matter

The first fifty pages deal with the fundamental likenesses of all living things. Four hundred twenty-five pages are devoted to the physiology, morphology, and economic importance of plants, invertebrates and vertebrates.

The last four hundred pages are distributed as follows: thirty pages to the relationship between plants, animals and environment; forty pages on anthropology and racial development; one hundred forty pages on human physiology; ninety pages on hygiene, sanitation and civic biology; twenty-six pages on Mendel's Laws, mutation, plant and animal breeding; forty pages on conservation; fifteen pages on the history of biology and six pages on the biology of to-morrow.

There is an abundance of material which is socially worthwhile; conservation, sanitation, civic biology, disease prevention, tobacco, alcohol and narcotics are given ample discussion.

Essential topics are covered. Cells, mitosis, embryology, paleontology, vitamins, endocrinology and genetics are some topics considered at length. Particularly commendable is the treatment of nature study and field work. These are integrated with the subject matter and not set aside as a special topic.

In the light of recent advances in the study of man the section on anthropology requires definite changes.

ALAN A. NATHANS, (*Chairman*)
MARTIN WEISS
BURTON WILEY
ABRAHAM WECKSTEIN

TO OUR MEMBERS

You are our best salesmen. Will you please hand the extra copy of the journal which you receive this month to some teacher of biology who is not a member of our association. Call to the attention of the prospective member the many advantages of belonging to a professional organization devoted to the advancement of the cause in which we are all deeply interested.

Mention the subscription blank on page 159.

TO OUR PROSPECTIVE MEMBERS

This copy of THE AMERICAN BIOLOGY TEACHER is being handed to you with our compliments through the courtesy of a member of The National Association of Biology Teachers. We hope that you too will wish to become a member of the association and a regular reader of the journal.

You are interested in promoting the healthy growth of your subject. We are interested in helping you. An increase in membership of 30% in one year indicates that we are serving a real need.

FOR YOUR BOOKSHELF

Field Book of Animals in Winter. Ann H. Morgan.

A splendid addition to the Field Book Series. It is written in easily understandable style and contains many drawings and photographs. This compact volume throws new light on the lives and habits of all types of animals during the cold winter months. G. P. Putnam's Sons. 1939. 416 pages. $3.50

Dictionary of Scientific Terms. C. M. Beadnell.

The author has scanned the newest scientific books and periodicals in an attempt to bring together those scientific terms which will interest the intelligent reader. Cross-references and the use of the synonyms and antonyms make it possible to locate desired terms readily. Chemical Publishing Co. 1938. 233 pages. $3.00

An Introduction to Genetics. A. H. Sturtevant and G. W. Beadle.

One of the most recent books in the field and designed by the authors as an elementary text in genetics. Broad principles rather than specific cases are emphasized throughout. The effects of irregular chromosomal behavior is given important consideration. Problems appear at the end of each chapter. A readable book that requires clear thinking. W. B. Saunders Co. 1939. 391 pages. $3.25

Bio-Ecology. F. E. Clements and V. E. Shelford.

Plants and animals seem to influence each other wherever and whenever found together. Therefore, the authors feel it is necessary to consider the fields of plant and animal ecology together, and do so in this volume. Although new terms are introduced occasionally, in general, the authors attempt to eliminate or simplify the more technical terms. An extensive bibliography is appended. John Wiley & Sons. 1939. 425 pages. $4.50

A Textbook of Histology. E. V. Cowdry.

An invaluable and standard text in histology, designed for the more advanced student. The number of pages has been increased in this revised edition and many new illustrations are included. An attempt has been made to design the book so that it may be employed not only as a text but also as a laboratory manual. Lea & Febiger. 1938. 600 pages. $7.00

Handbook of Nature Study. Anna B. Comstock.

A thoroughly charming and complete book. Although a revised edition of an older book, so many changes and additions have been incorporated, it may well be considered new. Teachers will find a series of excellently prepared lessons scattered throughout the book. It deserves a place on your bookshelf. Comstock Publishing Company. 1938. 937 pages. $4.00

An Introduction to Animal Physiology. W. B. Yapp.

Written in simple, understandable style this elementary work in physiology is designed for the student who has had a little experience in science. An excellent and lengthy section on nutrition is included. Oxford University Press. 1939. 297 pages. $3.00

Plant Physiology. B. S. Meyer and D. B. Anderson.

A successful attempt to bring together in a compact, well-bound volume, many of the newest developments in the field of plant physiology as well as a number of facts which have been established for some time. Questions at the end of each chapter are designed to carry out the authors' aim of establishing plant physiology as a practical tool to be used in the interpretation of plant behavior. D. Van Nostrand Co. 1939. 696 pages. $4.50

Book of the Broadleaf Trees. Frank H. Lamb.

One doesn't have to be a naturalist to thoroughly enjoy this book. The trees of the entire world are presented to the reader in vivid word pictures accompanied by many illustrations. The habits, uses and histories of various families are included as well as some interesting material on the various types

of "woods." W. W. Norton & Co. 1939. 367 pages. $3.75

Chordate Anatomy. H. V. Neal and H. W. Rand.

The large number of excellent illustrations —378 of them—are an attractive feature of this book. The authors' guiding theme is to present the various phases of comparative anatomy from the standpoint of evolutionary development. The importance of laboratory work in this subject is stressed and provided for in the general arrangement of the text. P. Blakiston's Sons. 1939. 467 pages. $3.50

A. A. F.

JUNIOR SCIENCE FAIR

The Junior Science and Engineering Fair held under the auspices of The Associated Junior Science Clubs of Pennsylvania, in cooperation with The Buhl Planetarium and Institute of Popular Science will meet in Pittsburgh, April 5, 6, 7, 8, 1940. All exhibits are the work of high school students. In the biological sciences these exhibits include plants and animals, medicine, bio-chemistry, bio-physics, and nature study.